

WHAT IS CLAIMED IS:

1. A golf club head comprising:
three discrete segments including a heel being formed of a first dense metallic material, a toe being formed of a second dense metallic material, and a center segment being formed of a non-metallic material having a density substantially less than the metallic materials comprising said heel or said toe, said heel, toe and center segment being joined together; and
a strike face extending across one side of said heel, toe, and center segment, said non-metallic material comprising said center segment being homogenous substantially entirely along at least one plane perpendicular to said strike face.
2. The golf club head of claim 1 wherein the non-metallic material has a homogeneous composition.
3. The golf club head of claim 2 wherein the first and second metallic materials each comprise at least two metals, and the first and second metallic materials each have a final alloy density of at least 7 grams per cubic centimeter.
4. The golf club head of claim 3 wherein the first and second metallic materials each have a final alloy density of 7 to 13 grams per cubic centimeter.
5. The golf club head of claim 4 wherein the first and second metallic materials each have a final alloy density of 9 to 11 grams per cubic centimeter.

6. The golf club head of claim 5 wherein the first and second metallic materials each have a final alloy density of approximately 10 grams per cubic centimeter.

7. The golf club head of claim 3 wherein the first and second metallic materials each comprise a first metal dispersed in a matrix of a second metal, the first metal having a higher density than the second metal.

8. The golf club head of claim 7 wherein the first metal has a density of at least 10 grams per cubic centimeter, and the second metal is selected from the group consisting of iron based alloys, nickel based alloys, and copper based alloys.

9. The golf club head of claim 1 wherein the non-metallic material is an elastomer.

10. The golf club head of claim 9 wherein the elastomer is a thermoplastic elastomer selected from the group consisting of styrene co-polymers, co-polyesters, polyurethanes, polyamides, olefins and vulcanates.

11. The golf club head of claim 10 wherein the elastomer is a polyurethane.

12. The golf club head of claim 1 wherein the club head is selected from the group consisting of iron-type club heads, wood-type club heads and putter-type club heads.

13. A golf club head comprising:
three discrete segments including a heel being formed of a first dense metallic material, a toe being formed of a second

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dense metallic material, and a center segment being formed of a non-metallic material having a density substantially less than the metallic materials comprising said heel or said toe, said heel, toe and center segment being joined together; and

a strike face extending across one side of said heel, toe, and center segment;

said non-metallic material comprising said center segment being homogenous substantially entirely along at least one plane perpendicular to said strike face,

wherein the first and second metallic materials each comprise at least two metals, and the first and second metallic materials each have a final alloy density of at least 7 grams per cubic centimeter.

14. The golf club head of claim 13 wherein the first and second metallic materials each have a final alloy density of 7 to 13 grams per cubic centimeter.

15. The golf club head of claim 14 wherein the first and second metallic materials each have a final alloy density of 9 to 11 grams per cubic centimeter.

16. The golf club head of claim 15 wherein the first and second metallic materials each have a final alloy density of approximately 10 grams per cubic centimeter.

17. The golf club head of claim 13 wherein the first and second metallic materials each comprise a first metal dispersed

in a matrix of a second metal, the first metal having a higher density than the second metal.

18. The golf club head of claim 17 wherein the first metal has a density of at least 10 grams per cubic centimeter, and the second metal is selected from the group consisting of iron based alloys, nickel based alloys, and copper based alloys.

19. The golf club head of claim 13 wherein the non-metallic material is an elastomer.

20. The golf club head of claim 19 wherein the elastomer is a thermoplastic elastomer selected from the group consisting of styrene co-polymers, co-polyesters, polyurethanes, polyamides, olefins and vulcanates.

21. The golf club head of claim 20 wherein the elastomer is a polyurethane.

22. The golf club head of claim 13 wherein the club head is selected from the group consisting of iron-type club heads, wood-type club heads and putter-type club heads.

23. A method of making a golf club head having a heel, a toe, and a center segment connecting the heel and the toe, the method comprising the steps of:

forming the toe of the golf club head from metallic material in a first forming operation;

forming the heel of the golf club head from metallic material in a second forming operation;

placing the heel and the toe in a molding die on opposite sides of a die chamber, the die chamber being shaped to form the center segment of the club head; and

forming the center segment of the club head by a plastic molding operation which introduces polymeric material into the die chamber whereby the center segment connects the heel and the toe in a unitary club head structure.

24. The method of claim 23 wherein the first and second forming operation are selected from the group consisting of cold isostatic pressing and pressureless sintering, room temperature die compaction and pressureless sintering, hot die compaction, injection molding, investment casting, and machining.

25. The method of claim 24 wherein:

at least one connecting surface formation is formed on a surface of the heel or toe in the first and second forming operations, and

the toe and the heel are placed in the molding die so that at least one connecting surface formation contacts the polymeric material when the polymeric material is introduced into the die chamber.

26. The method of claim 25 wherein:

the toe is formed so that a projection is developed in a surface of the toe,

the heel is formed so that a projection is developed in a surface of the heel, and

the toe and the heel are placed in the molding die so that both of the projections contact the polymeric material when the polymeric material is introduced into the die chamber.

27. The method of claim 25 wherein:

the toe is formed so that a recessed area is developed in a surface of the toe,

the heel is formed so that a recessed area is developed in a surface of the heel, and

the toe and the heel are placed in the molding die so that both of the recessed areas contact the polymeric material when the polymeric material is introduced into the die chamber.

28. The method of claim 24 further comprising the step of:

coating at least one surface of the toe or heel with a bonding agent,

wherein the toe and the heel are placed in the molding die so that at least one surface coated with the bonding agent contacts the polymeric material when the polymeric material is introduced into the die chamber.

29. The method of claim 23 wherein the non-metallic material is an elastomer.

30. The method of claim 29 wherein the elastomer is a thermoplastic elastomer selected from the group consisting of styrene co-polymers, co-polyesters, polyurethanes, polyamides, olefins and vulcanates.

31. The method of claim 30 wherein the elastomer is a polyurethane..

32. The method of claim 24 wherein the plastic molding operation is selected from the group consisting of resin transfer molding, injection molding, reaction injection molding, and compression molding.

33. The method of claim 24 wherein:

the step of forming the toe of the golf club head comprises filling a first mold having the shape of the toe of the golf club head with a first powdered metallic material, compressing the first powdered metallic material in the first mold at a pressure sufficient to form a green compact of the first powdered metallic material, removing the green compact from the first mold, and heating the green compact to an elevated temperature sufficient to form a sintered toe; and

the step of forming the heel of the golf club head comprises filling a second mold having the shape of the heel of the golf club head with a second powdered metallic material, compressing the second powdered metallic material in the second mold at a pressure sufficient to form a green compact of the second powdered metallic material, removing the green compact from the second mold, and heating the green compact to an elevated temperature sufficient to form a sintered heel.

34. The method of claim 33 further comprising the steps of:

inserting at least one metallic member into each of the green compacts before the green compacts are heated at an elevated temperature so that a projection is developed in a surface of the sintered toe and a projection is developed in a surface of the sintered heel,

wherein the sintered toe and the sintered heel are placed in the molding die so that both of the projections contact the polymeric material when the polymeric material is introduced into the die chamber.

35. The method of claim 33 wherein the first mold and the second mold are formed from elastomers.

36. The method of claim 33 wherein the step of compressing the powdered metallic material in the molds is performed by cold isostatic pressing and the step of heating the green compacts is performed without the addition of pressure.

37. The method of claim 33 wherein the sintered heel and the sintered toe formed from the step of heating the green compacts to an elevated temperature are near net shape.

38. The method of claim 33 wherein the powdered metallic materials each comprise at least two metals, and the sintered toe and sintered heel each have a density of at least 7 grams per cubic centimeter.

39. The method of claim 38 wherein the sintered toe and sintered heel each have a density of 7 to 13 grams per cubic centimeter.

40. The method of claim 33 wherein the first and the second powdered metallic materials each comprise a first metal dispersed in a second metal, the first metal having a higher density than the second metal.

41. The method of claim 40 wherein the first metal has a density of at least 10 grams per cubic centimeter, and the second metal is selected from the group consisting of iron based alloys, nickel based alloys, and copper based alloys.

42. The method of claim 33 further comprising the steps of:

forming the second mold so that a bore is developed in the green compact after compressing;

filling a third mold having the shape of a hosel of the golf club head with a third powdered metallic material;

compressing the powdered metallic material in the third mold at a pressure sufficient to form a green compact of the powdered metallic material;

removing the green compact from the third mold; and

inserting an end of the green compact formed in the third mold into the bore of the green compact formed in the second mold whereby the sintered heel formed when the green compacts are heated at an elevated temperature includes an integral hosel.

43. The method of claim 24 wherein:

the step of forming the toe of the golf club head comprises filling a first mold having the shape of the toe of the golf club

head with a first powdered metallic material and applying pressure and heat simultaneously to the first powdered metallic material to form a sintered toe; and

the step of forming the heel of the golf club head comprises filling a second mold having the shape of the heel of the golf club head with a second powdered metallic material and applying pressure and heat simultaneously to the second powdered metallic material to form a sintered heel.

44. The method of claim 43 wherein the sintered heel and the sintered toe are near net shape.

45. The method of claim 43 wherein the powdered metallic materials each comprise at least two metals, and the sintered toe and sintered heel each have a density of at least 7 grams per cubic centimeter.

46. The method of claim 45 wherein the sintered toe and sintered heel each have a density of 7 to 13 grams per cubic centimeter.

47. The method of claim 43 wherein the first and the second powdered metallic materials each comprise a first metal dispersed in a second metal, the first metal having a higher density than the second metal.

48. The method of claim 47 wherein the first metal has a density of at least 10 grams per cubic centimeter, and the second metal is selected from the group consisting of iron based alloys, nickel based alloys, and copper based alloys.

49. The method of claim 24 wherein:

the step of forming the toe of the golf club head comprises filling a first mold having the shape of the toe of the golf club head with a first liquid metallic material and allowing the first liquid metallic material to cool to form the toe; and

the step of forming the heel of the golf club head comprises filling a second mold having the shape of the heel of the golf club head with a second liquid metallic material and allowing the second liquid metallic material to cool to form a heel.

50. The method of claim 49 wherein:

the liquid metallic materials are formed by melting a bar of metallic material, the bar being formed by powder metallurgy techniques.

51. The method of claim 24 wherein:

the step of forming the toe of the golf club head comprises machining a solid piece of a metallic material to form the toe; and

the step of forming the heel of the golf club head comprises machining a solid piece of a metallic material to form a heel.

52. The method of claim 24 wherein:

the step of forming the toe of the golf club head comprises injecting a fluid mixture including a polymeric material and a metallic material into a first die chamber shaped to form the toe; and

the step of forming the heel of the golf club head comprises injecting a fluid mixture including a polymeric material and a metallic material into a second die chamber shaped to form the heel; and

the first and second die chambers are cooled to thereby form the heel and toe.

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